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SOURCE MX/TJ

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MEMORANDUM FOR: Michael J. Bell, Chief
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FROM: Timothy C. Johnson, Section Leader
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SUBJECT: SEALED SOURCES AS MIXED WASTE

At our February 7, 1989 meeting with the Department of Energy we were asked whether sealed sources, if considered for disposal, are mixed wastes. To respond to this question I investigated the chemical forms and materials used in the manufacture of sealed sources. This information was obtained from manufacturer catalogs from Amersham and Isotopes Products Laboratories.

The sources that are principal candidates for Greater-Than-Class C (GTCC) wastes are sources containing Am, Pu, and Cs. Am sources typically use americium oxide generally dispersed in a ceramic or aluminum matrix. These ceramic and aluminum discs are then encased in a welded stainless steel capsule. Some Am check sources that have activities that would allow disposal under 10 CFR Part 61 are manufactured by electro-deposition or vacuum sublimination of Am onto stainless steel discs. AmBe neutron sources are generally made by pressing americium oxide and beryllium metal powders. Pu sources are made of plutonium oxide. PuBe neutron sources are generally made by pressing Pu oxide into Be metal powders. Besides beryllium metal, neutron sources can use lithium hydroxide, boron metal, or calcium flouride. These materials are generally sealed in stainless steel capsules. Cs sources contain cesium chloride, cesium sulfate, or cesium silicate in a metal matrix, in a ceramic, or in the pure salt form. Smaller Cs check sources are sometimes embedded into a resin matrix. These materials are generally sealed in stainless steel capsules.

The materials used in these GTCC sources do not contain listed hazardous materials under 40 CFR Part 261, nor do they contain metals that may exhibit the characteristic of EP Toxicity. These GTCC sources, then, would not be considered mixed wastes. However, high activity sources are generally packaged in lead shields for handling and transportation. While lead shields do not specifically meet the definitions of hazardous wastes under 40 CFR Part 261, the Environmental Protection Agency has recommended that they be managed in the same manner as hazardous lead wastes.

There is a wide range of isotopes used in non-GTCC sealed sources. Table 1 lists many of these source nuclides and their principal chemical forms. The chemical forms listed in Table 1 show several source materials that require discussion. Arsenic, barium, cadmium, chromium, mercury, selenium and silver are heavy metals that may exhibit the characteristic of EP Toxicity. Because these metals are the radioactive materials used in the sources, they would be exempted from Resource Conservation and Recovery Act (RCRA) regulation as Atomic Energy Act byproduct material. These materials, then, would not be considered mixed wastes.

Table 1

Chemical Forms of Sealed Source Nuclides

Nuclide	Chemical Form
Ag	Silver metal
Am	Americium oxide
Ar	Arsenic oxide
Ba	Barium carbonate
C	Amorphous carbon
Cd	Cadmium metal
Cf	Californium oxide
Cm	Curium oxide
Co	Cobalt metal
Cr	Chromium metal
Cs	Cesium chloride, sulfate, or silicate
Fe	Iron metal
Gd	Gadolinium oxide
Hg	Mercury metal
I	Elemental iodine
Ni	Nickel metal
Pm	Promethium salt (insoluble)
Pu	Plutonium oxide
Se	Selenium metal
Sr	Strontium fluoride or titanate
Yb	Ytterbium oxide

Some sources are produced by electro-deposition onto copper, gold, nickel, platinum, silver, and stainless steel foils and discs. Other sources are made by embedding the nuclide chemical forms into aluminum, nickel, palladium, silver, ceramics, cermets, glass, nylon, resin, or ion exchange beads. Materials used in capsules and windows are commonly aluminum, stainless steel, beryllium, titanium, and zirconium. Of these materials only silver can be considered a potential hazardous material as it may exhibit the characteristic of EP Toxicity. I contacted G. Hanson and J. Goodrich-Mahoney of EPA and M. Mascarinek of Oak Ridge National Laboratory to find if they were aware of EP Toxicity Test data on silver metal. None, however, are unaware of specific test results on silver metal. Since this material cannot be considered byproduct material and, therefore, exempted from RCRA, sealed sources containing silver metals could potentially be mixed wastes. It should be noted, however, that EPA staff is evaluating the removal of silver from the EP Toxicity list due to expected changes in the Clean Drinking Water regulations and a petition from the photographic industry. If this action takes place, it is not expected in less than two to three years.

Standard source solutions are also available for various laboratory, medical, and research purposes. A wide variety of nuclides are available in the solutions listed in Table 2.

Table 2

Standard Source Solutions

Hydrochloric acid	Citric acid
Nitric acid	Formaldehyde
Sulfuric acid	Sodium thiosulfate
Water	Sodium sulfite
Saline solution	Glucose
Potassium cynanide	Ammonium hydroxide
Oxalic acid	EDTA
Tartaric acid	

Of these solutions only formaldehyde and potassium cynanide are listed in Subpart D of 40 CFR Part 261. These listings, however, are applicable to discarded commerical chemical products. Whether these two materials would be considered discarded chemical products would be dependent on their use. Solutions that exhibit the characteristic of corrosivity may also be candidates for mixed wastes. It is possible, however, that these solutions can be treated so that the final wastes does not exhibit a corrosive characteristic.

Numerous chemicals are also available in H-3 and C-14 tagged forms. These individual chemicals would need to be reviewed to determine if they are RCRA hazardous materials.

If you have questions, please contact me at 20558.

ORIGINAL SIGNED BY
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